

**Methods:** In this prospective study, 69 patients (69 joints) were included who received a navigated bicondylar surface replacement due to primary arthritis of the knee joint. In 67 cases in which a perfect soft-tissue balancing of the extension gap ( $<1^\circ$  asymmetry) was achieved, the flexion gap and the rotation of the femoral component necessary for its symmetry was determined and documented. The femoral component was implanted additionally taking into account the posterior condylar axis and the Whiteside's line. Post-operatively, the rotation of the femoral component to the SEA was determined and this was used to calculate the angle between a femur implanted according to the gap technique and the SEA.

**Results:** If the gap technique had been used consistently, it would have resulted in a deviation of the femoral components by  $-0.6^\circ \pm 2.9^\circ$  [ $-7.4^\circ$  to  $5.9^\circ$ ] from the SEA. The absolute deviation would have been  $2.4^\circ \pm 1.8^\circ$ , with a range between  $0.2^\circ$  and  $7.4^\circ$ .

**Conclusions:** Even if the extension gap is perfectly balanced, the gap technique does not lead to a parallel alignment of the femoral component to the SEA. Since the clinical results of this technique are equivalent to those of the femur first technique in the literature, an evaluation of this deviation as a malalignment must be considered critically.

### FP13-261

#### How does malrotation and material of the femoral component in TKA influence patellofemoral contact mechanics and wear during gait?

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**Objectives:** The aim of this study was to investigate the effect of malrotation of the femoral component on patellofemoral (PF) initial contact area, initial contact pressure and wear after 4 million full gait cycles in TKA using a knee simulator. The influence of the counterface material (CoCr or OxZr) on PF wear was also investigated.

**Methods:** Femoral components (FCs) were cemented onto specially designed fixtures, allowing positioning of the FC in different angles of axial rotation. Patellar buttons and FCs were then mounted in a Prosim knee simulator.

Patellar contact location, contact area and contact pressure were measured dynamically during 20 gait cycles with a Tekscan sensor covering the patella collecting data at a rate of 100 Hz. This was done for seven axial rotation configurations: neutral (FC parallel to the epicondylar axis),  $2.5^\circ$  endo- and exorotation,  $5^\circ$  endo- and exorotation and  $7.5^\circ$  endo- and exorotation.

For three alignments, a PF wear test of 4 million cycles in bovine serum (diluted to 40%) was done with three CoCr and three OxZr components on conventional ultra-high molecular weight polyethylene (UHMWPE, density:  $0.93 \text{ mg/mm}^3$ ). Every 0.5 million cycles the test lubricant was replaced, the patellar samples were cleaned and dried and polyethylene wear was measured gravimetrically. A linear regression model was used to calculate the wear rate of each patellar sample. Aggregate wear rates were determined for each test condition by pooling the measurements of all three patellar samples.

**Results:** For all six endorotation and exorotation configurations, the contact area was significantly lower and the contact pressure significantly higher than the neutral position ( $p < 0.001$ ). In the patellofemoral wear test, the highest average wear rate was found in the group of endorotated CoCr femoral components ( $0.54 \text{ mm}^3/\text{Mcycle}$ ), but this is still only 11% of a typical tibiofemoral wear rate with the same CoCr component ( $5 \text{ mm}^3/\text{Mcycle}$ ). The following trends in the average wear rates could be observed: the average wear rate for CoCr ( $0.34 \text{ mm}^3/\text{Mcycle}$ ) was higher than for OxZr ( $0.19 \text{ mm}^3/\text{Mcycle}$ ) and the average wear rate for  $5^\circ$  endorotation ( $0.35 \text{ mm}^3/\text{Mcycle}$ ) was

higher than for  $5^\circ$  exorotation ( $0.21 \text{ mm}^3/\text{Mcycle}$ ) and neutral alignment ( $0.23 \text{ mm}^3/\text{Mcycle}$ ). None of these differences reached statistical significance ( $p = 0.05$ ), though.

**Conclusions:** Our results indicate that both internally and externally malrotated femoral components significantly decrease contact areas and significantly increase contact pressures in the patellofemoral joint. These significant changes in contact pressure didn't translate in significant changes in wear, however. Overall, patellofemoral wear is very small compared to tibiofemoral wear, in all the configurations that we investigated.

Based on our results, we can conclude that clinical problems with patellar maltracking after femoral component malrotation seem not to be related to increased wear, but rather to pain and patellar instability.

### FP13-621

#### Intra-operative assessment of patello-femoral joint kinematics in total knee replacement and its correlation with femoral component position

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**Objectives:** In total knee replacement (TKR), surgical failures can occur for disorders at the patello-femoral joint (PFJ). Current navigation systems provide femur/tibia tracking for relevant bone preparation and assessments of tibio-femoral (TFJ) kinematics, disregarding completely the patella in case of resurfacing. Patellar tracking is made difficult by the small dimensions of this bone and by TKR surgical manoeuvres. A new technique has been developed recently for patellar bone tracking, which includes a suitable tracker and new surgical instrumentation for patellar resurfacing.

The aim of this study was to report on the first in vivo experiences of the intra-operative assessment of TFJ and PFJ kinematics in patients during TKR with patellar resurfacing. Correlation between patellar motion and femoral component position was also sought.

**Methods:** Ten patients affected by primary gonarthrosis were implanted with a posterior-stabilised prosthesis with patella resurfacing. All TKR were performed using a standard knee navigation system, which was enhanced by a specially-designed patellar tracker mounted onto the patellar anterior aspect.

Femoral/tibial bone implantation was performed according to the standard navigation. The patella was resurfaced and relevant resection plane was taken by an instrumented verification probe. Final position of the three components and lower limb alignment were also acquired.

Joint kinematics was deduced from the anatomical survey, which included also anatomical landmarks on the patella, and according to established recommendations and original proposals.

**Results:** Patellar tracking was performed successfully in all cases without complications and in addition to standard TFJ evaluations, resulting in a maximum of 30 min longer operations.

PFJ kinematics after femoral/tibial implantation and patellar resurfacing showed a mean ( $\pm$  standard deviation over the patients) range of flexion, tilt and medio-lateral shift respectively of  $66.9^\circ \pm 8.5^\circ$  (mean of minimum flexion-of maximum flexion,  $15.6^\circ$ – $82.5^\circ$ ),  $8.0^\circ \pm 3.1^\circ$  ( $-5.3^\circ$ – $2.8^\circ$ ), and  $5.3 \pm 2.0 \text{ mm}$  ( $-5.5$ – $0.2 \text{ mm}$ ).

Significant correlations were found between the internal/external rotation of the femoral component and the range of PFJ tilt ( $p = 0.05$ ;  $R = 0.64$ ), and between the mechanical axis alignment on the sagittal plane and the range of flexion-extension ( $p = 0.05$ ;  $R = 0.66$ ) and of antero-posterior shift ( $p = 0.04$ ;  $R = 0.67$ ) at the PFJ.

**Conclusions:** This preliminary experience supports the relevance, feasibility and efficacy of patellar tracking in navigated TKR. The results obtained reveal that patellar-based measurements are of good